Remarks

The applicants have corrected the error in claim 1. With regard to claim 19, this was amended in the previous response to be dependent on claim 1. There is a strike-through line in the figure "8" in the first line of claim 19, which the Examiner has apparently overlooked. Upon further inspection, it is believed that the Examiner will see that it is present. The applicants confirm that claim 19 is dependent on claim 1. The applicants have removed the parenthesis in the amended paragraph on page 3.

The Examiner's continued 102 rejection of the Sieval reference is based essentially on her continued assertion that Sieval discloses "porous silicon". It is respectfully submitted that this interpretation is clearly incorrect and untenable. Furthermore, the Examiner states that Sieval's wafers are made be essentially the process as the wafers of the present invention. This is simply not true as the Examiner has overlooked a very important step as will be explained in more detail below.

"Porous silicon" (PSi), not "porous" silicon is a well known term of art understood by persons skilled in solid state physics. The expression is used to describe silicon that has been treated by an anodic process to create pores extending into its surface in such a way that the electronic properties of the material are substantially altered. For example, porous silicon exhibits photoluminescence; ordinary crystalline silicon does not. A silicon crystal with a few incidental pores on its surface would not be described by one skilled in the art as "porous silicon". This term means something quite distinct to persons skilled in the art from ordinary crystalline silicon. The applicants are surprised, and somewhat frustrated, that the Examiner appears not to accept this basic premise as scientific fact. There is even a US class relating to "porous silicon" (see class 257 sub class E21.151). To further support this fact, the applicants are submitting herewith a Declaration under 37 CFR 1.132 executed by one of the present inventors, who is also an expert in this field.

In order to emphasize the fact that "porous silicon" is a term of art, its designation (PSi) as used in the specification has also been included in claim 1 (see line 7, page 1).

It is respectfully pointed out that the Examiner's assertion that Sieval is made by essentially the same method that is used in the present invention, i.e. by surface reaction with HF, is incorrect. In order to make porous silicon with HF, an electrochemical cell is

PAGE 8/21 * RCVD AT 12/31/2003 12:56:05 PM [Eastern Standard Time] * SVR:USPTO-EFXRF-1/1 * DNIS:8729306 * CSID:613 230 8821 * DURATION (mm-ss):04-50

essential. This is known *per se* by persons skilled in the art. The Examiner appears to have confused the two different HF treatments. If the Examiner refers to page 7, line 17 of the specification, she will see that in the exemplary process the wafers were initially immersed in HF solution for 1 min at room temperature to "remove the native oxide". Silicon forms a native oxide on its surface, and it is standard procedure to remove this native oxide by treatment in HF solution. This initial treatment, which does not result in the production of porous silicon, is similar to the treatment described in Sieval in the passage referred to by the Examiner and carried out for essentially the same purpose, namely to remove the native oxide. Sieval must remove the native oxide in order to apply his monolayers.

In order to produce porous silicon, it is necessary to perform the additional step of electrochemically etching the wafers in HF solution, i.e. in the presence of a current, which in the exemplary embodiment has a density of 5 mA/cm^2 (see page 7, line 21). Sieval does not perform this step, and as a result will not produce porous silicon. It is not therefore correct to say that the solid silicon of Sieval is made "porous" by the same method as that used in the instant invention. Moreover, upon reading the entirety of Sieval it is apparent that Sieval is working with crystalline, not porous, silicon. For example, in the abstract Sieval states that his monolayers are prepared on a silicon (100) surface. This implies crystalline silicon because the reference to the (100) surface would no longer have any meaning in the case of porous silicon due to the multitude of pores extending microscopic (i.e. 30 microns or so) distances into the surface.

In the paragraph headed "Conclusions" on page 1768, Sieval describes how a silicon (100) surface is not atomically flat due to the presence of SiH groups. However, such groups only result in a departure from roughness in the order of Angstroms, i.e in the order of the distance of atomic bonds. Sieval indicates that despite such "roughness" at the atomic level, stable monolayers can nevertheless be formed, the suggestion being that the surface should ideally be flat at the atomic level, but surprisingly some "roughness" at the atomic level can be tolerated. However, there is a huge difference between "roughness" at the atomic level and roughness at the microscopic level, such as created in porous silicon. Here the pores extend up to about 30 microns into the surface. 1 Angstrom

PAGE 9/21 * RCVD AT 12/31/2003 12:56:05 PM [Eastern Standard Time] * SVR:USPTO-EFXRF-1/1 * DNIS:8729306 * CSID:613 230 8821 * DURATION (mm-ss):04-50

= 10^{-10} meters, so the difference in the roughness referred to in the Sieval article and that occurring due to the porosity of porous silicon is in the order of 30,000!

Sieval cannot possibly anticipate claim 1 under 35 USC 102 because there can be no doubt at all that Sieval relates only to crystalline silicon and not porous silicon as the term is understood by one of ordinary skill in the art. "A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently, described in a single prior art reference." *Verdegaard Bros. v. Union Oil Co. of California*, 2 USPQ2d 1051. Sieval does not teach porous silicon (PSi) either expressly or inherently.

While it is in the applicant's respectful submission clear that Sieval is not citable under 35 USC 102, there is of course the need to consider the impact of 35 USC 103. Before discussing obviousness, the applicants wish to point out that the term *stable* or *stability* is not used in the present specification in quite the same sense as the term is used in the Sieval paper.

The present invention addresses a particular problem present in porous silicon, namely photoluminescence fatigue (see page 1, line 29). Chemical adsorbates lead to slow degradation of the photoluminescence properties of porous silicon, which restricts the use of PSi in commercial devices. The object of the invention is to stabilize the porous silicon surface in such as a way as to prevent or reduce this degradation effect. The solution is to use a particular passivating layer as claimed. As noted at page 4, line 17, et seq. ageing in ambient air for several months was found to have no effect on the photoluminescent intensity. The invention thus represents an important advance in the art of the fabrication of porous silicon devices for commercial application.

Sieval is an academic paper dealing with the stability of monolayers on a surface of crystalline silicon. [(100) surface or (111) surface]. The purpose of the monolayers is not clearly explained. There is a reference to "nonlinear optics" and "adsorption experiments" at the foot of the right hand column on page 1759. However, what *is* clear is that the underlying assumption in Sieval is that there is a basic need to place a monolayer on a silicon surface for some ill explained reason (for example to perfom adsorption experiments) and the problem is to form a monolayer that has "thermal stability" (see abstract). Also please see the sentence in the right hand column, page 1768: "Because of

PAGE 10/21 * RCVD AT 12/31/2003 12:56:05 PM [Eastern Standard Time] * SVR:USPTO-EFXRF-1/1 * DNIS:8729306 * CSID:613 230 8821 * DURATION (mm-ss):04-50

the exceptional stability of the monolayers when compared to the monolayers on gold and on silicon oxide, the protecting groups can be removed or modified, even when high temperatures are necessary. This is not the same problem as addressed by the present invention and has absolutely nothing to do with problem of "photoluminescence fatigue" addressed by the present invention.

There is no reason why one skilled in the art would consider Sieval relevant in addressing the problem at hand. The fact that Sieval's monlayers on crystalline silicon are thermally stable and allow protective groups to be removed or modified even at high temperatures would not suggest to a person skilled in the art that such monolayers could solve the photoluminescence fatigue problem outlined above. Sieval should therefore not be considered analogous art. In discussing the question of analogous art, the Federal Circuit, considering the need for a reference to be "reasonably pertinent" has stated in *In re Wood*, 202 USPQ 171, that:

> [a] reference is reasonably pertinent if...it is one which, because of the matter with which it deals, logically would have commended itself to the inventor's attention in considering his problem...If a reference disclosure has the same purpose as the claimed invention, the reference relates to the same problem...[I]f it is directed to a different purpose, the inventor would accordingly have had less motivation or occasion to consider it.

Sieval teaches nothing about how to deal with the problem of photoluminescence fatigue, and is actually directed to a very different problem. Sieval does not even discuss the formation of passivating layers. Sieval clearly has a very different purpose. Sieval starts from the assumption that a monolayer is required for some purpose, and the problem is how to form this monolayer on the surface so that this monolayer is among other things thermally stable, that is it does not decompose when subjected to heat. There is no reason why one skilled in the art addressing the problem of photoluminescence fatigue in porous silicon would find any assistance in the Sieval article, which relates among other things to the thermal stability of monolayers on crystalline silicon, but in no way teaches that such monolayers would be useful in solving the problem noted above in porous silicon.

PAGE 11/21 * RCVD AT 12/31/2003 12:56:05 PM [Eastern Standard Time] * SVR:USPTO-EFXRF-1/1 * DNIS:8729306 * CSID:613 230 8821 * DURATION (mm-ss):04-50

Clearly, then Sieval does not suggest a solution to the problem at hand. Moreover, it would make no sense for one skilled in the art to apply the disclosed monolayers in Sieval to porous silicon (PSi) based on a complete reading of Sieval. Sieval teaches the use of a crystalline surface (100) or (111). The object is to produce dense monolayers. There is some discussion in the Conclusions that despite surface roughness at the atomic level, "stable monolayers" can be prepared. Since Sieval clearly considers a slight departure from atomic flatness due to the presence of SiH groups a potential problem, but one that can be tolerated ("Despite this surface roughness dense monolayers can still be prepared" – see Conculsions), clearly one skilled in the art would not, based on this teaching, be motivated to deliberately introduce massive surface roughness at the microscopic level by introducing pores that remove the crystal surface entirely. It makes no sense, based on a complete reading of Sieval, to say that one skilled in the art would be motivated to apply its teachings to porous silicon for any reason.

The entire paragraph on page 3 of the office action commencing "Applicant's argument is unconvincing..." completely overlooks the fact that in order to make porous silicon from crystalline silicon you must provide an electrochemical cell. Such a cell is completely absent in Sieval for the simple reason that Sieval does not make porous silicon. The present application starts from (100) wafers and treats them in HF solution to remove the native oxide, as does Sieval. However, Sieval states that after treatment in HF solution (which removes the native oxide), his wafers were "immediately" placed in "the deoxygenated alkene" unlike the present invention where the wafers are subjected to a subsequent electrochemical etching in HF solution in the presence of a current. This is necessary in order to produce the porous silicon, as is know per se in the art.

In the applicant's respectful submission the Examiner's 102 rejection against claim 21, which expressly includes the electrochemical etching step, is therefore clearly erroneous. The Examiner appears to have completely overlooked the electrochemical etching step, which is the very step that converts crystalline silicon to porous silicon, and which is clearly missing in Sieval for the good reason that Sieval is only concerned with crystalline silicon.

PAGE 12/21 * RCVD AT 12/31/2003 12:56:05 PM [Eastern Standard Time] * SVR:USPTO-EFXRF-1/1 * DNIS:8729306 * CSID:613 230 8821 * DURATION (mm-ss):04-50

In summary, it is respectfully submitted that the Examiner's rejections are based on a misinterpretation of Sieval. It is impermissible to read into a reference more than actually stated. Sieval clearly relates to crystalline silicon, not porous silicon as the term has come to be clearly understood in the art. In order to produce porous silicon, a crystalline silicon must be subject to a first HF treatment to remove native oxide (This treatment does not result in porous silicon; on the contrary it results in crystalline silicon having a very smooth surface) and a second HF treatment in the presence of an electric current to produce porous silicon. Sieval clearly lacks the second step and does not therefore produce porous silicon.

The invention solves an important problem in the art, namely the stabilization of the photoluminescence properties of porous silicon, properties that are not even possessed by the crystalline silicon discussed in Sieval. This is a very surprising result that is not foreseen anywhere in the prior art and particularly not in Sieval, which does not address this problem. If the problem of photoluminescence fatigue were explained to one skilled in the art, there is absolutely no basis to suggest that such a person would be motivated to apply the teachings of Sieval to porous silicon, but even if such a basis were established "obvious to try" is not a sufficient basis to establish obviousness. See *In re Lindell*, 155 USPQ 521.

Sieval cannot therefore be considered analogous art, but even it if were, there would be no motivation for one skilled in the art to turn Sieval's silicon into porous silicon because Sieval strives for an atomically flat surface to produce his desired dense monolayers. There is no suggestion in Sieval that alkenes would penetrate pores of porous silicon or that any useful pupose would be served thereby.

Reconsideration and allowance are therefore respectfully requested. Especially in view of the fact that the Examiner's rejection appears to be based on an erroneous interpretation of Sieval, the applicants respectfully request a telephone interview if the Examiner has any further objections.

PAGE 13/21 * RCVD AT 12/31/2003 12:56:05 PM [Eastern Standard Time] * SVR:USPTO-EFXRF-1/1 * DNIS:8729306 * CSID:613 230 8821 * DURATION (mm-ss):04-50

USSN 09/803,044

Art Unit 1641

Respectfully submitted

Marks & Clerk
P.O.Box 957, Station B
Ottawa, Ontario
Canada K1P 5S7
(613) 236-9561

BY: _____
Richard J. Mitchell
Reg. No. 34519

PAGE 14/21 * RCVD AT 12/31/2003 12:56:05 PM [Eastern Standard Time] * SVR:USPTO-EFXRF-1/1 * DNIS:8729306 * CSID:613 230 8821 * DURATION (mm-ss):04-50